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First practical application of quantum weak measurements, used to perform the first experimental investigations of the Spin Hall Effect of Light[1]

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I will talk about the first observation of the spin Hall effect of light (SHEL), an effect so basic yet unsuspected until 2004, which entails tiny (sub-wavelength) spin-dependent transverse displacements of a beam of light when it changes its propagation direction in a generic fashion. The effect is the photonic version of the spin Hall effect in electronic systems, indicating the universality of the effect for particles of different nature. A novel metrological technique is developed for the observation of the effect, using the concepts of quantum weak measurements as an amplification tool. This technique genuinely enabled the first measurements of the effect by enhancing the original displacements by nearly four orders of magnitude. In subsequent experiments we attained sensitivity to displacements as small as $\sim$5 pm. Being quite a general technique, the weak measurement enhancement results stimulated more research into applications of the effect in a variety of settings. The original SHEL measurements were performed at an air-glass interface, but I will also talk about our recent work on observing SHEL in media with a smoothly varying index of refraction where the photon trajectories are determined by a Lorentz-type force due to an effective magnetic monopole in momentum space.

[1]This work was performed at the University of Illinois at Urbana-Champaign under the supervision of Paul G. Kwiat.